Patent Application

of

Thomas Thompson, 92-543 Kokole Pl. Makakilo, HI 96707

for

HURRICANE-EARTHQUAKE FRIEZE PLATE

Background-Field of Invention

This invention relates to one of my previous inventions in application #08/578,081, filed 12/26/96, and is an innovative connector that permanently connects the roof to the outside wall which creates buildings that are stronger and more resistant to hurricanes and earthquakes.

Background-Description of Prior Art

Background

Recent studies of hurricane damage on wood-frame buildings indicate that extensive damage was generated to a house by strong winds, when the roof rafters, roof trusses, and roof purlins twisted or were torn from the outside wall.

Roof sheathing ties all the rafters or purlins together on a wood frame house, and the roof sheathing ties all the roof trusses together when a masonry or wood-frame house is constructed with trusses. If the rafters or trusses rack or twist from the wind forces, the roof sheathing can detach from the roof allowing wind and rain to enter the house.

Roof sheathing that is tightly secured to the rafters or trusses and subsequently fastened to the walls, helps transfer uplifting forces to the walls and henceforth to the foundation. If the roof sheathing fails, the trusses collapse, and the walls usually fall down as they can not stand by themselves against strong winds.

Roof trusses can take tremendous compression pressure, but are usually weakly attached to the top plate of the wall by toe-nailing or prior art hurricane clips. During house construction, when a rafter or roof truss is attached to the erect wall, it is usually fastened by toe-nailing or driving a nail at an angle into a thin edge of the rafter and into the top plate.

Toe-nailing is a weak, but time honored way of constructing rafters and trusses. Driving a nail at an angle usually moves the rafter off it's correct location on the top plate. This invention forms a much stronger building connection without toe-nailing or fragile hurricane clips.

Hurricanes

Studies of damage after Hurricane Andrew show several problems with the attachment of roof rafters and roof trusses that this invention solves.

Roof overhangs act like wings, creating huge uplifting forces during strong winds. This uplift tears apart the rafters that are toe-nailed to the header or top plate. The uplift can also twist rafters and roof trusses weakening the toenailed connections and causing detachment.

One significant factor in building construction is precision framing, where the rafter is installed directly above the stud. Unfortunately, in many houses this is rarely the case.

Post-and-beam construction is very common in older homes in mild-weather areas, and we have found that the wall studs, or in this case, posts, are only under every fourth rafter, and the rafters can be 4-feet on center. Usually, the posts are directly under where the top plate butts up against the top plate in the run. The rafter is to one side of this butt joint, so the rafter does not line up directly over the post.

On newer stud-wall construction, we have seen that studs rarely line up directly under the rafters. We saw a house where the walls have studs 16-inches on center, constructed with a roof that had rafters 24-inches on center. This means the only rafter and stud that will line up to form a continuous load-path is every fourth stud or every other rafter. What are the odds that they will exactly line up?

A Federal Emergency Management Agency (FEMA) Publication, FIA-23 , "Building Performance: Hurricane Iniki in Hawaii" shows undersized and improperly attached metal fasteners (Figures 26-27).

Because of the shape of all roofs, wind blowing across a roof tends to lift the roof off the walls as shown in FIA-23, Figure 48. The most important tie in an existing house is between the rafter and top plate or roof truss and top plate. Any uplifting wind force on the roof must be transferred to the walls.

Another problem with home construction is on mis-installation of prior art hurricane clips. After Hurricane Andrew, there were many examples of careless and inferior attachment of hurricane clips or they were entirely missing. One company has visited new construction sites and documented many examples of shoddy and incorrect application of their products.

Earthquakes

During an earthquake, the floor, wall, and roof diaphragms undergo shearing and bending. The shear forces from the walls are transferred from the top plate to the roof by way of toenails to the roof members. To withstand and transfer the shear loads, the connection between the roof and wall must be strong.

Steel connectors, between different components of a wood-frame building superstructure, provide continuity so the house will move as a unit in response to seismic activity (Yanev, 1974).

The outside sheathing provides lateral stability to the walls, preventing racking. The sheathing also absorbs and transfers earthquake forces by becoming a shear wall. In order for the wall to perform as a shear wall, the sheathing must stay intact. This invention makes a strong and rigid connection between the roof rafters or trusses, the top plate, and the wall sheathing.

Construction

Many houses are still built with the time-honored method of toe-nailing the rafter or roof truss to the top plate of the wall. This weak method drives a nail at a steep angle through a thin edge of the rafter into the top plate. Any uplifting force splits the rafter or pulls the nail out.

Exact measurements are usually performed to get the rafters in the correct location, but toe-nailing or striking the rafter at a steep angle shifts the rafter even when striking it from nailing on the opposite side. Installing this invention can cut measuring time drastically and eliminates toe-nailing so the rafters or trusses are exactly on-center.

Hurricane clips and straps have been used in the past, but they are thin, weak and only tie a thin edge of the rafter and top plate together.

Prior Art

A number of connectors have been developed to tie together the structural members of a house under construction. Up until this invention, nobody had seen how to make a connector that could tie the roof rafters together and to the wall top plate, exactly space out the distance between rafters, provide ventilation to the attic, tie into the roof sheathing, and provide a strong box-like shape that prevents lateral movement during an earthquake, prevents thrusting when heavy loads are placed on the roof, and prevents uplift during a hurricane.

My pending application, serial number 08/191,852, is a retrofit hurricane clip. Although it can be mounted on 2x rafters, it was designed for large timber rafters such as 4x stock, and was adapted as a retrofit onto existing houses. It ties the roof rafter to the outside wall sheathing and underlying top plate while avoiding existing blocking.

My co-pending application, serial number 08/578,081 shows a metal frieze board that ties the roof rafters to the top plate and outside wall sheathing. It too provides ventilation and prevents uplift.

My other pending application, serial number 09/001,744 shows a retrofit hurricane clip that ties the roof rafter to the outside wall sheathing and underlying top plate.

A leading manufacturer of wood construction connectors, the Simpson Strong-tie Company, shows no connectors in their catalog that tie the roof rafters to the wall top plate, exactly space out the distance between rafters, provide ventilation to the attic, can tie into the roof sheathing, and provide a strong box-like shape that prevents lateral movement during an earthquake and prevents uplift during a hurricane.

There are a number of ties that fasten the rafter to the top plate while a house is being constructed including: Knoth US Patent Number 5,561,949, McDonald US Patent Number 5,560,156, Colonias US Patent Number 5,380,115, Stuart US Patent Number 5,335,469, Colonias et al Patent Number 5,109,646, Commins US Patent Number 4,714,372, Gilb US Patent Number 4,572,695, and Gilb et al US Patent Number 4,410,294.

These are good inventions, but they do not tie two rafters together to form a strong box-like section. The prior art hurricane clips provide little lateral strength, even when using a left and right. The prior art cannot tie the roof sheathing to the underlying top plate and roof rafter. They cannot prevent the roof sheathing from being blown off during strong winds of a hurricane. They do not prevent the roof sheathing from splintering and disconnecting during earth tremors.

Frye's anchor system, US Patent Number 5,311,708, is patented as a retrofit, but it does not tie the rafter to the top plate and ties into the weakest thin edge of the rafter while splitting it with bolts. Frye's 708 also provides no lateral support against side movements.

Netek's reinforcing tie, US Patent Number 5,257,483, is patented as a retrofit and may clear frieze boards, but it is temporary, and like Frye, ties into an even weaker thin edge of the end

of the rafter. Netek's 483 also provides no lateral support against side movements.

There are several retrofit apparatus for securing roofs using cables. Adams US Patent Number 5,570,545 and Winger US Patent Number 5,319,896 are both temporary, meaning a homeowner must be home to deploy and anchor the ephemeral cables. The anchors can only be as secure as the nearby soil and the cables do not prevent the walls from bowing or blowing out.

There are a number of joist hangers that fasten to a joist and vertical member while a house is being constructed including: Colonias et al US Patent Number 5,104,252 and Gilb US Patent Number 4,480,941. These are good inventions, but they provide little lateral strength.

Joist hangers have a small ledge that supports all the weight from the joist beam. They hang the weight from the edge, rather than supporting the weight on top of the edge. They are also thin and parallel to the long dimension of the joist beam, concentrating all that carrying weight onto a vertical thin- section of the vertical member.

Gilb's complicated hanger, US Patent Number 4,261,155, is strong, but it does not perform the same functions as this invention.

Prior art connectors relied on angled nailing, to provide lateral support, which is complex to manufacture, and very difficult to install around structural beams. My invention effectively ties together adjacent rafters or roof trusses to the top plate to form a strong box-like section between the rafters, top plate, and the roof sheathing.

Objects and Advantages

Accordingly, several objects and advantages of my invention are that it helps secure the roof and wall of a building to make the building a solid unit and helps prevent it from being destroyed by hurricanes and earthquakes.

This invention helps prevent the roof from being blown off the walls of building. It keeps the roof rafters and roof trusses tightly secured to each other and the top plate of the wall.

This invention helps prevent the roof rafters and roof trusses from twisting during strong winds, thereby preventing detaching of the roof material and roof sheathing. It stiffens the edge of the roof and the top of the wall, helping to transfer lateral loads to the whole roof and walls.

This invention makes the top of the wall very sturdy and helps make the outside wall into a stable shearwall, transferring lateral forces into the foundation and ground.

One object of this invention is to make each outside wall on a house into a shearwall, that is, able to transfer forces without breaking, distorting, or disconnecting at the rafter connection. By tying the top plate and rafter or roof truss tightly together, the wall can reliably transfer and dissipate shear and lateral forces to the ground.

During an earthquake or a hurricane, a building with my invention will be a sturdy unit, resisting and transferring destructive forces to the ground. Studies of previous earthquakes show that wall sheathing tries to slide past each other, but this invention ties the sheathing securely to the underlying structural members.

Many older homes were constructed with the best materials and by competent carpenters, but used the time-honored method of connecting the rafter to the top plate with nails driven into the edge of the rafter. This weak connection, called toe-nailing, is still in use today. Even if prior art hurricane clips were used in construction, the homeowner can't tell, and those clips don't tie adjacent rafters together to the wall.

Mounted on the rafters and roof sheathing, this invention resists uplift, one of the most destructive forces of a hurricane. Mounted on the top plate and wall sheathing, the invention helps prevents the top of the wall from bowing out by the extreme negative pressure of a hurricane.

During an earthquake, when my connector is mounted on the roof and walls, they will help make the walls stiffer and therefore a shear wall. The secured wall will absorb and dissipate earth movements, without becoming detached from the roof.

This would improve the house beyond existing building codes, as sheet metal joints have been proven to perform better than nailed joints during hurricanes and earthquakes.

Another object of this invention is ventilation for the attic. During the winter, ventilation will help prevent ice dams. During the summer, ventilation will help cool the attic, lowering cooling bills.

Yet another advantage of this invention is during earthquakes, nails can sometimes bend with the movements of the house, but screws often break. Even though screws hold tighter than nails and provide a tight connection against uplifting forces from hurricanes, they are less resistant against earth movements. This invention absorbs and transmits most of the forces during an earthquake and hurricane so nails and/or screws can be used as fasteners.

Another advantage is that since the invention absorbs and transfers earthquake and hurricane forces, less nails and nailing could be used. Also, screws could be used in the invention in earthquake areas with less fear that the heads will shear off.

Still another advantage is that with the roof rafters and roof trusses better able to resist twisting, roof sheathing will stay firmly attached and roofing material will now have a better chance of staying on during strong winds and earth movements. In addition, with the sheathing now firmly connected, new materials may be attached to the roof, such as solar electric panels, without fear of them being blown off.

In areas with brush or forest fire danger, fire-proof material or heavy material, such as tile, stone or metal, can now be applied to the roof with less danger of being blown or shaken off during earth tremors or high winds. The invention resists thrusting, or the weight of the roof pushing outward on the wall, since the roof is now securely attached to the wall.

Earth tremors and hurricanes always destroy the weakest parts of a house. By making the vertical walls and roof envelope into a strong unit, there will be less damage.

It is a further object of this invention that it easily, quickly, and economically protects houses from the destructive forces of earthquakes and hurricanes. It is a still further object that the connectors and fasteners are strong, attractive, permanent, functional, uncomplicated, simple to manufacture, easy to install, and economical. All of the embodiments can be made from a single sheet metal blank, without any welding.

Many houses are still built with the time-honored method of toe-nailing the rafter or roof truss to the top plate of the wall. This weak method drives a nail at a steep angle through a thin edge of the rafter into the top plate. Any uplifting force splits the rafter or pulls the nail out.

Exact measurements are usually performed to get the rafters in the correct location, but toe-nailing or striking the rafter at a steep angle shifts the rafter even when striking it from nailing on the opposite side. Installing this invention between rafters or trusses cuts measuring time drastically and eliminates toe-nailing so the rafters or trusses are exactly on-center.

A further object is that this invention can be used on various size sheathing, rafters, roof trusses, studs, wood or metal I-beams, TJI, and glue-lams, all made from wood or metal. There may be insurance discounts for homeowners who have this invention installed on their houses.

Traditional toe-nailing of the rafter is at the bird's-mouth, a notch cut into the rafter where it rests on the top plate. By cutting out material from the rafter, a bird's-mouth weakens the rafter. Toe-nailing only two nails from either side grasps only a small edge of the rafter, and the nail only extends into the top 2x of the top plate. This invention can make cutting birds mouths into the rafter unnecessary.

Tests were done by the Colorado School of Mines on my co-pending retrofit hurricane clip, application serial number 08/191,852. The tests showed that the rafter split lengthwise, due to uplifting force, before my 852' clip failed. The rafter tabs on this invention may prevent the rafter from splitting and will hold the rafter together even if the rafter splits lengthwise at the connector.

This new retrofit invention strengthens the rafter to top plate connection by vastly increasing the spacing and amount of nails in the thickest part or "meat" of the rafter. This clip also strengthens the bird's mouth by wrapping on either side of the rafter and keeping it from splitting along the long measure.

Another advantage is with two adjacent rafters tied together and to the top plate, it tremendously increases resistance to thrusts. This makes the roof much stronger and able to resist more weight such as thick snow, ice, or volcanic ash, and heavy roofing material such as tile, insulated roofing, solar collectors, and satellite dishes.

This invention takes the place of a left and right prior art hurricane clip, thus cost and installation time is substantially reduced. Installation can be accomplished with a hammer, power nailer, or powered screw gun.

Since this invention fills the space between rafters, wood blocking does not have to be cut to fill the space, thus saving trees and labor. The invention can be made from recycled steel. By forming a box-like section, torsional twisting is significantly reduced over prior art hurricane clips. Cross-grain splitting, where the sheathing pulls away from nails driven on its edge, is avoided with this invention and its large surface area on the wall sheathing, and on the roof sheathing.

The left and right rafter tabs, that are installed on opposite sides of the rafter have offset nail holes. Nails driven into the rafter will be offset from each other lessening wood splitting and vastly increasing holding power.

This invention can be made as an adjustable frieze plate which allows the invention to be installed as a retrofit. By holding the outside sheathing tightly to the top plate, the invention makes the wall into a strong shear wall. The invention can also be used under the top plate to tie the wall studs to the top plate and outside sheathing. The invention can also be used on the sill plate to tie the wall studs to the sill and outside sheathing.

By adding a simple embodiment, the roofing material and roof sheathing can be held down to the roof rafter. This invention can hold down roof sheathing to the rafter or roof truss, providing great rigidity to the entire house. This makes the house significantly more resistant to strong winds and earth tremors.

These and other objectives of the invention are achieved by simple and economical connectors that allow a builder or home owner to quickly and easily secure the weakest parts of a building against earth tremors and high winds.

Advantages of each will be discussed in the description. Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

Brief Description of the Drawings

FIG. 1	is a perspective view of a frieze plate.
FIG. 2	is a perspective view of two frieze plates mounted on a house.
FIG. 3	is a rear view of a frieze plate showing box section.
FIG. 4	is a flat pattern layout showing nesting.
FIG. 5	is a perspective view of a two-piece frieze plate.
FIG. 6	is a perspective view of a runner.
FIG. 6A	is a side view of a runner.
FIG. 7	is a flat pattern layout for a two-piece frieze plate.
FIG. 8	is a flat pattern layout of a frieze plate and grasp.
FIG. 9	is a perspective view of a grasp.

Reference Numbers for Drawings

1. Modern Frieze plate
2. Front face
3. ~~Wall tab~~ Lower face
4. Left rafter tab

4A. Left rafter bend

5. Right rafter tab

5A. Right rafter bend

6. Left plate tab

6A. Left plate bend

7. Right plate tab

7A. Right plate bend

8. Left sheathing tab

8A. Sheathing bend

9. Right sheathing tab
10. Ventilation rib
11. Roof tie

11A. Alternate roof tie

12. Carriage bolt
13. Washer
14. Nut
15. Oblong bolt hole
16. Nail hole
17. Bolt hole
18. Left reinforcement tab
19. Right reinforcement tab
20. Adjustable frieze plate
21. Left frieze plate
22. Right frieze plate
23. Track

23A. Track opening

24. Runner

24A. Runner arms

25. Grasps

25. Bump out

26. Window
27. Top hook
28. Barbs
29. Nail hole

A. Top plate

B. Rafters

C. Roof sheathing

D. Wall sheathing

E. Wall stud

Description of Drawings

Figure 1

Figure 1 shows a perspective view of a modern frieze plate **1**. The front face **2** has ventilation ribs **10** punched toward the viewer. The ventilation ribs **10** provide strength by work-hardening the metal and provide ventilation to the attic when installed on a house. The ventilation ribs **10** open to the air from the bottom preventing rain from entering the building. The ventilation ribs **10** can be left off the modern frieze plate **1** or punched in but not open to the air.

The bottom part of the front face **2** has a wall tab **3** that extends along the bottom edge. When mounted to a building, the wall tab **3** extends down along the outside sheathing **D** and the underlying vertical edges of the two top plates **A** and ties both together. When the top plate contains only one plate, the bottom part of the wall tab **3** can tie into a wall stud. The wall tab **3** has nail holes **16** for attachment to the outside sheathing **D** and top plate **A**.

The left side of the modern frieze plate **1** contains a right-angle left rafter bend **4A** which forms a left rafter tab **4** with nail holes **16** for attachment to the wide side of a rafter or roof truss **B**. The right side of the modern frieze plate **1** contains a right-angle rafter bend **5A** which forms a right rafter tab **5** with nail holes **16** for attachment to an adjacent rafter or roof truss **B**.

Figure 1 shows that the wall tab **3** extends below the left rafter tab **4** and the right rafter tab **5** for easy attachment to the vertical edge of the top plate **A** or outside sheathing **D**. Attached to the bottom of the left rafter tab **4** is a right angle bend which forms a left plate bend **6A**. The left plate bend **6A** forms the left plate tab **6** (bent under) with nail holes **16** for attachment to the wide horizontal edge of the top plate **A**.

Attached to the bottom of the of the right rafter tab **5** is a right angle bend which forms a right plate bend **7A**. The right plate bend **7A** forms a right plate tab **7** (bent under) with nail holes **16** for attachment to the horizontal edge of the top plate **A**. Figure 1 shows how the left rafter tab **4**, the left plate tab **6**, the front face **2**, the wall tab **3**, the right rafter tab **5**, and right plate tab **7** forms an open box section.

This box section effectively ties together two adjacent rafters or roof trusses **B** and the underlying top plate **A** while evenly spacing apart the rafters **B**. Using a powered nail or screw driver, a framer can space and install the rafters **B** much quicker than prior hurricane clips.

After the modern frieze plate **1** is attached to the rafters **B**, top plate **A**, and outside sheathing **D**, roof sheathing **C** can be installed. Attached to the top of the front face **2** is an approximately right angle bend that forms a sheathing bend **8A**. The sheathing bend **8A** forms the left sheathing tab **8** and the right sheathing tab **9** with bolt holes **17**. The sheathing bend **8A** and the left rafter bend **4A** bends the left reinforcement tab **18** with bolt hole **17** under the left sheathing tab **8**.

On the right top part of the modern frieze plate **1** the sheathing bend **8A** bends the right sheathing tab **9** at an approximately right angle to the front face **2**. The sheathing bend **8A** and the right rafter bend **5A** bends the right reinforcement tab **19** with bolt hole **17** under the right sheathing tab **9**. Both reinforcement tabs **18-19** are hidden in this view. The reinforcement tabs **18-19** are not essential, but they add great strength to the sheathing tabs **8-9**.

When roof sheathing **C** is laid on top of the rafters or trusses **B**, nails or staples are normally used to secure the sheathing down tight. Previous hurricanes have shown that roof rafters are easily ripped off a house, because the nails are essentially in the same plane as uplifting forces. This invention puts the nails in shear.

Figure 2

Refer now to figure 2 which shows a perspective view of modern frieze plates **1** attached to a building. On the right modern frieze plate **1**, the left rafter tab **4** has been secured to a rafter **B** and the left plate tab **6** has been secured to the top plate **A**. The wall tab **3** is secured to the front of the top plate **A**. The right rafter tab **5** is secured to a rafter **B** (not shown) and the right plate tab **7** is secured to the horizontal face of the top plate **A**.

On the left modern frieze plate **1**, the right rafter tab **5** is secured to the vertical face of a rafter **B** and the right plate tab 7 is secured to the horizontal face of the top plate **A**. The wall tab **3** is secured to the wall sheathing **D** and underlying top plate **A**.

A roof tie **11** is used to tie roof sheathing **C** to the modern frieze plate **1** and to tie adjacent frieze plates **1** together. After the modern frieze plate **1** is attached to the top plate **A** and rafters **B**, a hole is drilled from below the roof sheathing **C**, up through the bolt holes **17** of the sheathing tabs **8- 9**, and through the roof sheathing **C**.

Roof ties **11** are placed over the drilled holes, and carriage bolts **12** are placed in the

oblong bolt holes **15** from the roof . The oblong bolt holes **15** allow for adjustment and keeps the carriage bolt **12** from turning. The carriage bolt **12** also passes through the drilled hole in the sheathing **C** and through bolt holes **17** in the sheathing tabs **8-9**. Washers **13** can be used above and below the sheathing tabs **8-9**. Tapered washers **13** can be used for steeply pitched roofs. Nuts **14** are used to tighten the carriage bolt **12** to the underside of the reinforcement tabs **18-19**.

Figure 2 shows that adjacent rafters or trusses are now tied securely together. The rafters are also tied securely to two dimensions of the top plate. The roof sheathing is also tied to two or more rafters and to the top plate. Uplifting forces from a hurricane would have a hard time lifting the edge of the roof sheathing as the roof tie **11** forms a large surface area, like a washer, on top of the roof sheathing.

The roof tie can be rectangular or square like the alternate roof tie **11A**. The roof tie **11** can have other shapes to hold down sheathing and other materials on top of a roof. Strong winds would find it difficult to lift the rafter from the top plate, twist the rafters, or blow the walls in or out.

Studies have shown that when an earthquake strikes, there is an uplifting force and then ground shaking. With the walls and roof now tied together securely with the modern frieze plate **1**, the roof can act like a shear wall, absorbing and transmitting forces to each strongly attached wall which will also act as shear walls. Since the house can move as a solid unit there will be less damage to the house and its contents.

Figure 3

Refer now to figure 3 which shows a perspective view of a modern frieze plate **1** on a building viewed from inside the building. Part of the top plate **A** is cut away in this view to show how the wall tab **3** can tie into the outside sheathing **D** and vertical edge of the top plate **A**. This view also has the roof sheathing **C** cut away to show how the carriage bolt **12** ties the sheathing **C** to the rafter **B**, and indirectly to the top plate **A**, outside wall sheathing **D**, and wall stud **E**.

Figure 3 also shows the strong box section that the left plate tab **6**, left rafter tab **4**, left sheathing tab **8**, right sheathing tab **9**, right rafter tab **5**, and right plate tab **7** make between the rafters **B**, top plate **A**, and roof sheathing **C**.

The strong box-shape gives the invention great strength and resistance to forces from multiple directions. Thrusting, or the force of the weight of the roof pushing the walls outward is countered by the rigid connection between the rafters **B** and the top plate **A**. The rafter tabs **4-5**, plate tabs **6-7**, and wall tab **3** prevent thrusting force. Similarly, inward pressure of wind forces is countered by the rafter tabs **4-5**, plate tabs **6-7**, and wall tab **3** .

Lateral or sideways movement is associated with earthquakes and strong winds from the side. This movement is also referred to as racking, where the wall would lean to the left or right as viewed from the front. Instead of being square or rectangular with right angles, the wall would be rhomboid or parallelogram-shaped. Racking would be avoided during construction because of the positive connection between the rafters, and the positive connection between the rafters and top plate. Lateral movement is also averted by the box shape of the installed invention.

During hurricanes or strong winds, parts of the roof can have a twisting or torque force applied to the rafter. This force can rip out the toe nailed connections and twist prior art connectors. This invention prevents twisting of the rafter **B** because of the positive connection to adjacent rafters **R**, and to the top plate **A**, roof sheathing **C**, and outside sheathing **D**. Adjacent rafters **B** are connected together with this invention and connected to the top plate **A**.

The front face **2** of the modern frieze plate **1** is similar to blocking, preventing twisting or movement of the rafters while saving wood, carpentry labor, time, and money. Prior blocking was usually cut for the uneven space between each rafter and toe nailed to the rafter. This invention takes the place of blocking while providing a strong connection between the rafters **B**, top plate **A**, wall sheathing **D**, and roof sheathing **C**.

Dramatic photos and videos of roofs being lifted off the wall during a hurricane shows the weak connection on old and new houses. Much of the debris shown on these videos are roof sheathing and roof rafters. This invention helps prevent uplift and detaching of the rafters and roof sheathing by tying the roof sheathing **C**, rafter **B**, top plate **A**, and outside sheathing **D** together.

On some houses constructed with 2x4 rafters or trusses, it may be difficult to drill up through the bolt holes 17 for attaching roof ties 11, since there is only 3½ inches of room . The left reinforcement tab 18 and right reinforcement tab 19 can be bent in forming a strong box section. The left sheathing tab 8 and right sheathing tab 9 can be bent out toward the outside of

the house. This will make drilling up easy, as nothing is in the way, and the connection and box section is still strong and intact.

Prior construction methods of toe nailing along the bottom of the rafter only caught a thin edge of the rafter. It did not matter if the rafter was a 2x4, 2x6, or 2x8, only an inch or less of corner was held to the top plate. These nails are in the same general direction of uplift. When uplift was applied in testing at the Colorado School of Mines in Colorado, the rafter split or the nails pulled out under low loads. No prior art was found that ties adjacent rafters **B** together, ties them to the horizontal and vertical face of the top plate **A**, and ties into the outside sheathing **D** and roof sheathing **C**.

Figure 3 shows how the rafters **B** are now tied to the top plate **A** on the horizontal face by plate tabs **6-7**, and along the vertical face of the top plate **A** by the wall tab **3**. Uplift of the rafters **B** is now prevented by nails or screws that would have to be sheared the entire length of the top plate **A** between rafters; nails or screws that would have to be sheared the entire width of the rafter **B**; and nails or screws that would have to be pulled out of the width of the top plate **A**.

After Hurricane Andrew in Florida, it was found that many of the staples used to hold down the roof sheathing had rusted away. Investigators also found that many of the roof sheathing sheets on the ground showed that the nails had gone through the sheathing, but had missed the underlying rafter or only caught a thin edge. Some sheets had no evidence of ever being nailed down to the rafter. (FEMA publication FIA-22 on Hurricane Andrew).

Figure 3 shows how roof sheathing **C** is tied to the rafter **B** with metal connectors. The roof tie **11**, left sheathing tab **8**, left rafter tab **4**, and left plate tab **6** form an I-beam shape against the left side of the rafter **B**. The opposite side also form an I-beam shape against the right side of the rafter **B**. This is a very strong shape that is used in engineered buildings with wood and steel throughout the world. This I-beam shape prevents the rafter **B** from splitting, twisting, or detaching from the roof sheathing **C** or top plate **A**. No prior art connector was found with an I-beam shape.

Figure 3 shows the modern frieze plate **1** attached to the outside sheathing **D** and front face of the top plate **A**. The modern frieze plate **1** can also be attached to the inside or rear face of the top plate **A**. The modern frieze plate **1** can also be made with the left side tabs **4, 6, 8** facing

inside and right side tabs **5, 7, 9** facing outside or vice-versa. The modern frieze plate **1** could also be made with tabs facing outside, and in two pieces as on the adjustable frieze plate **20**.

Figure 3 shows the modern frieze plate **1** attached to the outside sheathing **D**. The outside sheathing **D** is attached to the wall studs prior to the rafter installation because the sheathing makes the wall more resistant to racking. A modern frieze plate **1** can be installed upside-down on the inside of the stud wall right below the top plate. The wall tab **3** would be attached to the vertical face of the top plate **A**, the plate tabs **6-7** would be attached to the horizontal underside of the top plate **A**, and the rafter tabs **4-5** would be attached to the vertical sides of the wall studs **E**. For installation on the studs, the sheathing bend **8A** would not be bent, making the sheathing tabs **8-9** horizontal. The sheathing tabs **8-9** would then be used to fasten the outside wall sheathing **D** to the stud using roof ties **11**, similar to roof sheathing **C** attached to a rafter **R**.

Similarly, a modern frieze plate **1** can be installed where the sill plate and wall stud **E** come together. The modern frieze plate **1** can be installed to the outside, before the wall sheathing **D** is installed, or on the inside of the wall. The wall tab **3** can be installed on the vertical face of the sill plate. The left and right plate tabs **6-7** can be attached to the horizontal face of the sill plate. The rafter tabs **4-5** can be attached to the inside of the wall studs.

For installation on the sill, the sheathing bend **8A** would not be bent, making the sheathing tabs **8-9** horizontal. The sheathing tabs **8-9** can then be used to fasten the outside wall sheathing **D** to the stud using roof ties **11**, similar to roof sheathing **C** attached to a rafter **R**.

Figure 4

Refer now to figure 4 which shows a flat pattern layout for a modern frieze plate **1** with ventilation ribs **10**. The ventilation ribs **10** can be changed by moving pins on the tool and die and strengthening ribs could be substituted. With standard construction widths between rafters being 16 or 24 inches-on-center, the length of the front face **2** could be 14½ inches or 22½ inches to evenly space out standard 1½ inches-wide 2x lumber. If the construction industry changed dimensions or went metric, the length of the front face **2** can be changed to comply.

The vertical dimension of the front face **2** is not as critical as the length, since the modern frieze plate **1** can be moved up or down, and in or out before being nailed, but not left to right. The modern frieze plate **1** can be installed by positioning the first rafter in the correct position,

preferably the first rafter on the gable end. A modern frieze plate **1** is then attached to that rafter, the outside sheathing, and the underlying top plate. Another rafter is then installed to the other end of the modern frieze plate **1** and so on down the wall. At places where the rafter or truss is doubled up, an adjustable frieze plate **20** (shown on figure 5) can be used. An adjustable frieze plate **20** could be used for accommodating windows, doors, dormers, and the like.

Once the rafters are anchored to the top plate, the roof sheathing is attached to the rafters and roof ties **11** are bolted to the sheathing tabs **8-9**. This ties down the most critical part of the roof sheathing, right above where the interior part of the house starts.

Figure 5

Refer now to figure 5 which shows a flat pattern layout of a modern frieze plate 1. The modern frieze plate **1** nests during manufacture, which saves material and money.

Figure 6

Refer now to figure 6 which shows an adjustable frieze plate **20**, which can be used on rafters that are not standard distance apart. This embodiment, the adjustable frieze plate **20**, can also be used as a retrofit on existing homes. Many homes have soffits or eaves that are non-structural and in disrepair. The soffits can be taken down and adjustable frieze plates **20** can be installed. The adjustable frieze plates **20** will strengthen the house, provide ventilation, and keep out bugs, all at a price much lower than replacing the soffits with non-working soffits.

The adjustable frieze plate **20** consists of two connected pieces that slide parallel to each other. The left frieze plate **21** and right frieze plate **22** look like a modern frieze plate**1** that has been cut in two. Both left and right frieze plates **21-22** have wall tabs **3** that can be attached to the outside wall sheathing **D** and underlying top plate **A**.

The left frieze plate **21** has a left rafter tab **4** that is formed out at the left rafter bend **4A**. The right frieze plate **22** has a right rafter tab **5** that is formed out at the right rafter bend **5A**. By forming the rafter tabs **4-5** to the outside instead of in like the modern frieze board **1**, they allow the rafter tabs **4-5** to be attached to the rafters **B** from outside the house.

In order to be adjustable onto differently-spaced rafters **B**, the adjustable frieze plate **1** can change the distance between the left rafter tab **4** and right rafter tab **5**. By sliding horizontally on tracks **23** and runners **24**, the left frieze plate **21** and right frieze plate **22** can be adjusted so the

left rafter tab **4** and right rafter tab **5** are flush against adjacent rafters **B**. The tracks **23** and runners **24** hold the left and right frieze plates **21-22** together and slide horizontally while still having great structural integrity against uplift, twisting, thrusting, and lateral loads.

On the top part of the adjustable frieze plate **20**, there are left and right sheathing tabs **8-9** and underlying reinforcement tabs **18-19**. On existing homes, a hole can be drilled up through the bolt holes **17**, through the roof sheathing **C**, and through the roofing material. A roof tie **11** is placed over the hole and silicone caulk is applied around the carriage bolt **12** before it is inserted through the special bolt hole **15**. A nut **14** is tightened from below and the roofing material and roof sheathing **C** is now secured to the rafters **B**, top plate **A**, and outside sheathing **D**.

Figure 7

Refer now to figure 7 which shows a flat pattern layout of an adjustable frieze plate **20** and a perspective view of a runner **24** on a right frieze plate **22**, that fits into a track **23** on a left frieze plate **21**, and allows the adjustable frieze plate **20** to slide horizontally.

The runner **24** is punched out and away from the front face **2** during the forming process, but is still attached to the face **2** by runner arms **24A**. The runner arms **24A** are slightly smaller than the track **23** that they will slide along. The wide face of the runner **24** prevents the runner from falling through the track **23** except at the track opening **23A**.

It can be seen how the wide head of the runner **24** will fit through the track opening **23A**, and the runner arms **24A** will slide snugly along the track **23**. The track **23** can be longer for more adjustment by eliminating the ventilation rib **10**.

The track **23** can be on the right frieze plate **22** and the runner **24** can be on the left frieze plate **21**. The runner **24** could be punched completely out and a bolt **12** and nut **14** could be used to tightly fasten the adjustable frieze plate **20** together, but the track **23** and runner **24** is quicker.

The left frieze plate **21** contains the track **23** and track opening **23**. The right frieze plate **22** contains the runner **24** and runner arms **24A**. Once the runner **24** is installed into the track opening **23A**, the runner arms **24A** can slide the entire distance along the track **23** without detaching. This provides a wide adjustment for the rafter tabs **4-5** to adjacent rafters **R**.

Figure 8

Refer now to figure 8 which shows the left side of a modern frieze plate **1**. The wall tab **3**

can be made longer to tie into a wall stud **E**, but that will use a lot of material. To save material, grasps **25** can be connected to the front face **2** of the modern frieze plate **1**.

A grasp 25 is connected to the front face **2** through a bump out **26**, which is a semi-circle ring that is punched forward on the front face **2**. The top hook **28** of the grasp **25** hooks around the bump out **26** at an angle, and is fastened when swung down. The barbs **29** of the grasp **25** poke through the window **27** which is stamped out of the front face **2**. The barbs **29** can be driven into the wall sheathing **D** and underlying top plate **A**.

The bump outs **26** can be angled out to the side so that a long grasp **25** can lock into a wall stud **E**, which is usually under the rafter **B**. The wall stud **E** can actually be anywhere under the top plate **A**, and a long grasp **25** can be inserted into other bump outs **26** in order to tie into the wall stud **E**.

Figure 9

Refer now to figure 9 which shows a perspective view of the grasps **25**. The top hook **28**, barbs **29**, nail holes **30** are shown. It can be seen how the top hook **28** locks into the bump out **26** from the inside so it is secure to the front face **2** of a modern frieze plate **1**. The barbs **29** can have several different shapes, but the shape of the curved fork will be driven easily into the sheathing. A nail driven into the nail holes **30** will securely lock the modern frieze plate **1** to structural members of a building. The grasps 25 can be of various length as they can be applied in the field by the contractor to fit on different size structural members and to fit different codes. The barbs **29** form a strong connection when placed through the window **27**, but the barbs **29** do not have to go through a window **27** if long nails or screws are used in the nail holes to secure into the structural members.

Conclusions, Ramifications, and Scope of Invention

Thus the reader will see will see that the modern frieze plate of the invention provides a practical, strong, rudimentary connector that can be quickly installed by standard construction methods yet saves time and resources.

While my above description contains many specificities, these should not be construed as limitations on the scope of the invention, but rather as an exemplification of one preferred embodiment thereof. Many other variations are possible. For example there can be minor variations in size, and materials. For example, the ties can have more rounded corners, squarer corners, wavy lines instead of straight lines, more nail holes, slightly less nail holes, or be thicker or thinner, wider or longer. The ties can be made for 2x4's and 3/4 inch sheathing, or 2x6's with 5/8 inch sheathing or many other combinations of sheathing or beam size.

The ties can have different dimensions to fit the particular plans of the engineer and architect. In areas that have high winds or earthquakes, the ties could be thicker, wider, or have more nail holes.

The roof ties **11** can hold down boards instead of roof sheathing; they can also hold down insulated sheets, metal sheets, plastic sheets, roof tiles and roofing material.

The ties can have a variety of shapes stamped in the roof ties **11** to hold down a variety of objects against sheathing such as brackets for solar heaters or solar collectors.

The ties can have an underpass stamped in the wall tab **3** to hold down cable, wire, belts, or metal bands on top of the wall sheathing.

The ties can have a round shape on the face in order to fit on curved walls.

The ties can be made of metal by stamping, forging, or casting. The ties can be made of plastic, by molding or casting. The ties can be made of recycled materials. The ties can be made with bright colors, so a builder or inspector knows they are in position. They can be of different thicknesses, for different strength on different applications.

Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their legal equivalents.